## Gas Constants

$$0.08206 \frac{\text{L•atm}}{\text{mol•K}} = 8.31 \frac{\text{L•kPa}}{\text{mol•K}} = 8.31 \text{ J / (mol•K)}$$

$$\frac{0.08206 \text{ L•atm}}{\text{mol•K}} \left| \frac{101325 \text{ Pa}}{1 \text{ atm}} \right| \frac{1 \text{ kPa}}{1 \text{ X10}^3 \text{ Pa}} = 8.31 \frac{\text{L•kPa}}{\text{mol•K}}$$

↑ convert atm to Pa

↑ convert Pa to kPa

{cancel $m^2$}

By definition: **1 N•m = 1 joule**

↓

$$\frac{0.08206 \text{ L•atm}}{\text{mol•K}} \left| \frac{1 \text{ dm}^3}{1\text{L}} \right| \frac{1 \text{ X10}^{-3} \text{ m}^3}{1\text{dm}^3} \left| \frac{101325 \text{ Pa}}{1 \text{ atm}} \right| \frac{1 \text{ N/m}^2}{1 \text{ Pa}} = 8.31 \frac{\text{N•m}}{\text{mol•K}} = 8.31 \text{ J / (mol•K)}$$

↑ ↑ ↑

↑ convert atm to Pa

↑ By definition: **1 Pascal = 1 $N/m^2$** {force / area}

↑ **Newton**

By definition: **1 N = 1 kg•m / $s^2$**

$(1 \text{ dm})^3 = (1 \text{ X10}^{-1} \text{ m})^3$

$1\text{dm}^3 = 1 \text{ X10}^{-3} \text{ m}^3$

## Root Mean Square Velocity of $O_2$ at 273 K:

$O_2 = 31.998$ g/mol → 0.031998 kg/mol

$v_{rms} = \sqrt{\overline{3RT/m}} =$

$$\sqrt{\overline{\frac{(3)(8.31 \text{ J/(mol•K))(273 K)}}{(0.031998 \text{ kg/mol})}}} = \sqrt{\overline{212697 \frac{\text{J}}{\text{kg}}}} = \sqrt{\overline{212697 \frac{\text{N•m}}{\text{kg}}}} = \sqrt{\overline{212697 \frac{(\text{kg•m/s}^2)\text{•m}}{\text{kg}}}} = \sqrt{\overline{212697 \text{ m}^2/\text{s}^2}} = \mathbf{461 \text{ m/s}}$$

↑ Multiply & Divide, then cancel K & mol.

↑ 1 joule = 1 N•m

↑ 1 Newton = 1 kg•m/$s^2$

↑ {cancel kg}